Space Weather Technical Forecast

Issued on Saturday, 15 October 2022 at 13:00 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-flare risk declining.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has returned to Low or Very Low levels, with isolated low level C-flares. Both AR3112 and AR3116 have now rotated off the Earth-facing disc, over the northwest limb, however significant magnetic looping is still evident from this complex. This leaves one numbered and two un-numbered small and simple sunspots on the disc, in the northwest quadrant. There are also a number of filaments on the Earth-facing disc, one of these erupted in the southwest at 14/2200 UTC. Modelled results indicate that the bulk of the ejecta will pass below Earth orbit, and although a weak glance around midnight UTC on the 18th is possible, no significant impacts are anticipated.

No other Earth-directed CMEs have been observed.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by ACE and DSCOVR at L1, is indicative of the connection with CH32, perhaps combined with some weak CME influence at first. Background speeds at 380 km/s increased, at times rather erratically, to peak at recent elevated levels of 530 km/s. Density was initially above average around 20 ppcc, but soon returned to mostly average levels. The total IMF strength, Bt, was often Moderate with peak values 15-18 nT near the start of the period, but has become weak in recent hours. The north-south component, Bz, fluctuated moderately and was southward directed at first reaching -14nT at 14/1224 UTC, but has again become weak in recent hours. The phi angle was mostly negative (towards the Sun). Geomagnetic activity was Active (Kp 4) 14/1200-1500UTC, and G1/Minor Storm 15/0000-0300UTC. Otherwise, Quiet to Unsettled (Kp 1 to 3).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES16, has remained at background levels. High energy electron flux at GOES16 (greater than 2MeV) was mostly at Background levels. The associated fluence was still just above the Active (1e8 integrated pfu) threshold at the start of the period with peak value 1.27e8, but quickly declined thereafter to be well below Active levels. The 15/0000 UTC observation was 3.83e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be mostly Low, with a chance of rising to Moderate on day 1 (15th), mainly from any flares from AR3112. While this is no longer on the Earth-facing disc, the associated magnetic looping remains visible above the northwest limb, potentially allowing any notable flares to be observed from Earth.

Solar Wind / Geomagnetic Activity: There are no Earth-directed CMEs, however the peripheral effects of CMEs passing south of Earth late day 2 or 3 (16th or 17th), and again around midnight UTC on the 18th may be observed. Otherwise, ongoing fast wind influence from CH32/- is expected to ease towards background. Geomagnetic activity is forecast to be Quiet to

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Unsettled, but with a chance of Active intervals early day 1 (15th), or late day 2 (16th) into early day 3 (17th), and again around midnight UTC on the 18th.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10MeV) is expected to be at background levels. High energy electron flux (greater than 2MeV) has dropped out to near background levels, although flux levels are likely to recover during the period, perhaps reaching High at diurnal peak. The associated 24hr fluence is expected to persist below the Active (1e8 integrated pfu) threshold, but likely rising later in the period. There is a chance of Active fluence by the end of day 3 (17th).

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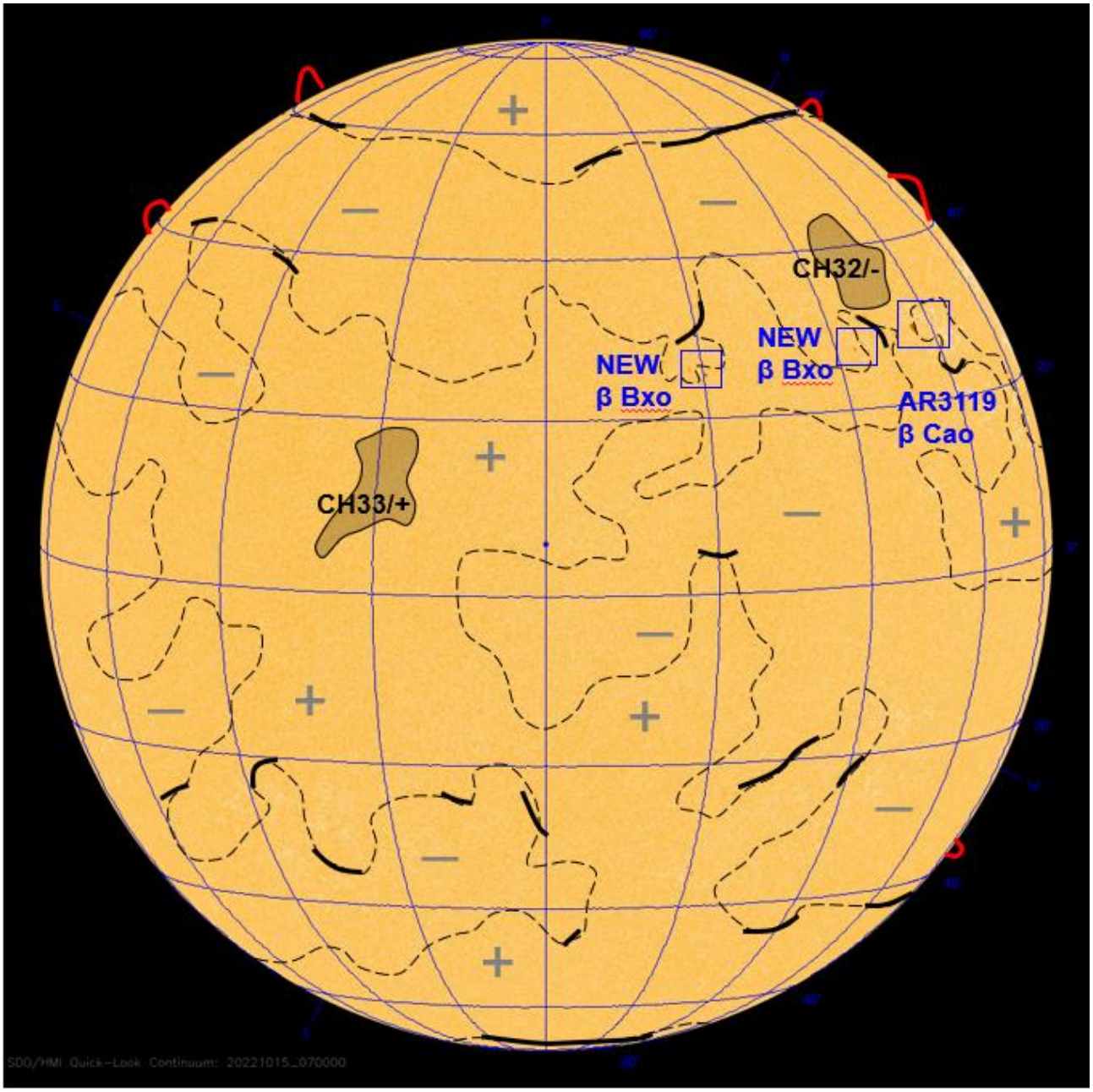
Figure 1. Solar Analysis Valid 15/0730UTC.



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Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Met Office Space Weather Technical Forecast

Geomagnetic Storms:

There are no Earth-directed CMEs, however a CME was observed from a filament eruption from the southern centre disc early on the 13th. The bulk of the material is expected to pass below Earth's orbit, however peripheral glancing effects are possible, most likely late day 2 (16th) on early day 3 (17th). Similarly, another filament erupted in the southwest at 14/2200 UTC. Modelled results indicate that the bulk of the ejecta will also pass below Earth orbit, and although a weak glance around midnight UTC on the 18th is possible, no significant impacts are anticipated.
Current fast wind enhancement from CH32/-, perhaps amplified by the peripheral influence of a passing CME on the 14th, is expected to persist day 1 (15th) leading to slightly elevated to elevated winds peaking around or just below 500 km/s. These winds then gradually easing back towards background through the rest of the period. No other coronal hole features are expected through the period.
Geomagnetic activity is forecast to be Quiet to Unsettled, but with a chance of Active intervals early day 1 (15th) from ongoing fast wind effects, or with any possible influence from the glancing CMEs late day 2 (16th) or early day 3 (17th), and again around midnight UTC on the 18th.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	10	5	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
13/1610	Partial	Filament eruption	S-centre	408 km/s	Missing	Chance of peripheral influence late 16th or early 17th
15/0600	Partial	Filament eruption	SW	520 km/s	Missing	Chance of peripheral influence late 17th or early 18th

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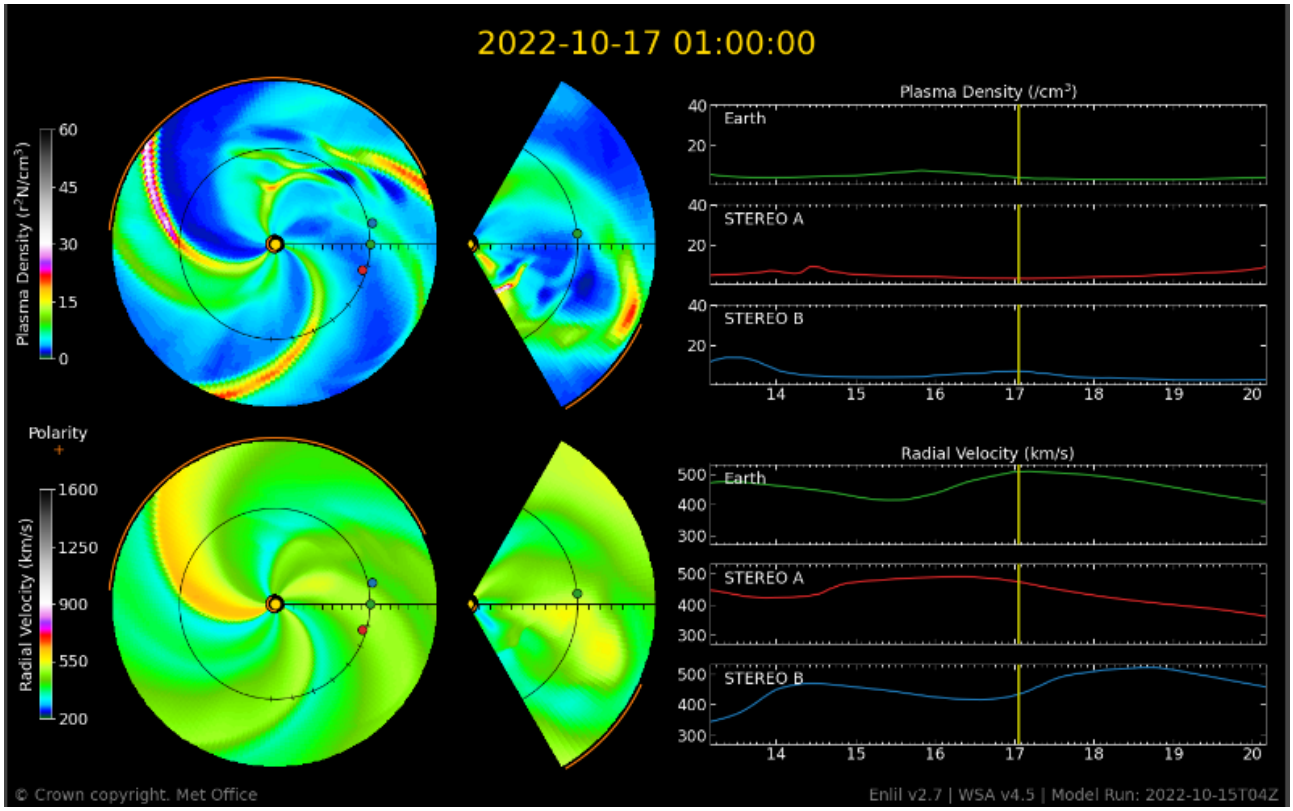
Figure 2: Enlil showing first of possibly two CMEs passing below Earth orbit.



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Radio Blackouts - X-Ray Flares:

Solar activity has returned to Low or Very Low levels, with isolated low level C-flares. AR3112 has now rotated off the Earth-facing disc, over the northwest limb. However, with significant magnetic looping still present and visible on SDO imagery from this region, a risk of further M-flares is maintained through day 1 (15th), reducing thereafter. AR3119 (Cao/Beta) is now the only numbered region on the visible disc, and is small, simple group showing signs of decay. Two other small and simple regions have emerged in the northwest quadrant in the past 24 hours but are currently un-numbered.

A returning region may begin to appear at the southeast limb by the end of the period.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	20	5	5	5
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10MeV) as observed by GOES-16 is currently at background levels and expected to remain at this level. AR3112 has now rotated off the disc, and whilst far-sided flares can produce a proton response at Earth, the lack of response from recent M-flares reduces this potential.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	2	1	1	1
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

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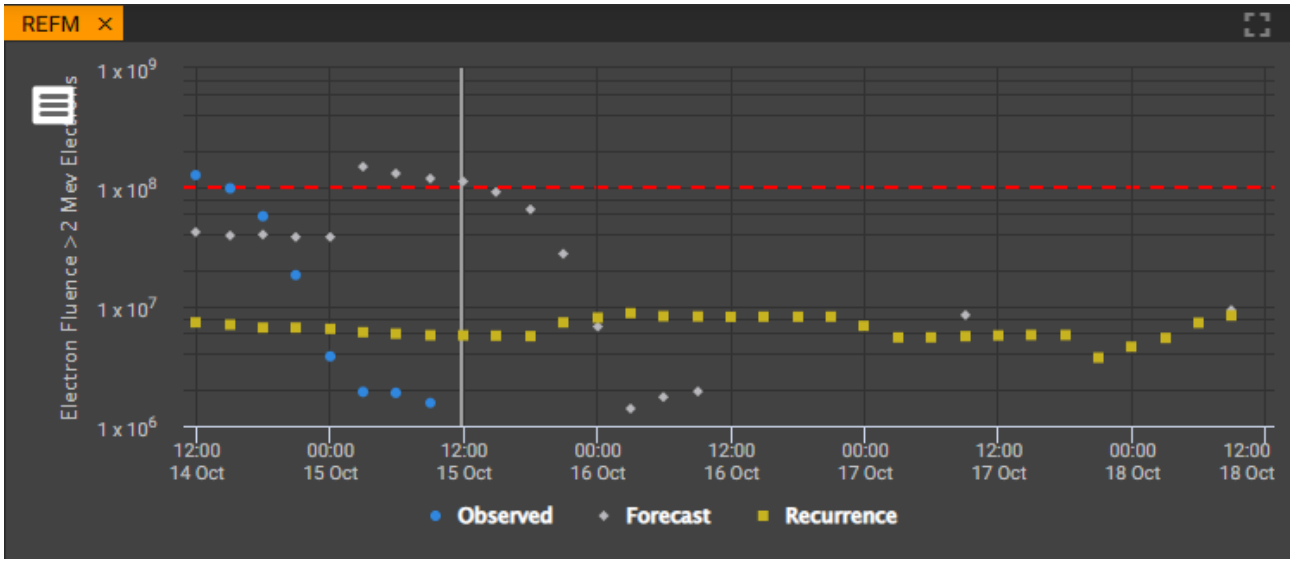
High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) as observed by GOES-16 has been at background, having dropped out due to impact of the recent fast wind arrival from CH32/-. Electron flux is expected to increase again as solar winds ease, rising to Moderate, and perhaps reaching High at diurnal peak, although with low confidence.

The associated 24 hour electron fluence is likely to remain below the Active level, but with a rising trend as flux levels increase. There is a chance that this may approach, or perhaps exceed Active by day 3 or day 4. REFM has yet to correct for the current fast winds, so is unreliable, despite also suggesting that fluence levels will remain below the Active level.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	5	20	30	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: MOSWOC REFM



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